

The Importance of Hydrographic Surveying in the Development of a Water/Lake Transportation System in Ghana

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Key words: Hydrography, Transportation, Hydrographic Surveying, Volta Lake.

ABSTRACT

Over the past decades, transportation in Ghana has dominantly depended on land by road and slightly rail systems which has caused a lot of pressure on our road/rail facilities leading to their early damages. In the case where access roads exist, due to the bad nature of the roads, vehicles are either unable to get to the production sites and vice versa. Ghana is fortunate to have a major water body along the southern boundary of the country, i.e. the Gulf of Guinea and a major river body, the Volta Lake linking the southern section to the northern section. Safety in the use of our water bodies depends greatly on the nature of the water bodies, their depths and what is below the surface of the water. The Volta Lake can be very important for transportation providing a waterway for both ferries and cargo watercraft [5]. But due to fear from users who claim its unsafe use, there is the urgent need to develop an approach that would determine the safety and effective use of the water body for the development of the water transportation system.

This paper analyzes the need to conduct hydrographic surveying on our water bodies to determine the level of safety its use for the development of a Water Transportation System. It also creates the awareness in the importance of hydrographic surveying to determine the safety in the use of water body and concludes that the development of a Water Transportation System in Ghana can be made possible with a highest level of safety with the conduction of a hydrographic survey to determine the topography of the Volta Lake.

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1.0 INTRODUCTION

Transportation in Ghana over the decades has dominantly depended on land either by the road and rail systems. Access roads to coastal and lakeside settlements have not been the best due to the bad road nature and possibly the unavailability of link roads to the settlements. Travelers, goods and food stuffs from these villages and isolated towns along the coast and rivers have to be transported through difficult means to the closest delivery/arrival points. This kind of movement takes so long a time and for that matter its effect on perishable goods either by expiring or getting rotten. In the case where access exists, due to the bad nature of the roads and most often only one narrow access, vehicles are either unable to get to the production sites or vice versa. The use of fishing canoes has been the available mechanism for transporting people and goods which has endangered lives over the past periods due to unavailability of safety measures. In all these, it can be realized that easy and good access roads have become very necessary to these communities and towns along the water bodies in order to have easy transportation of travelers, goods and food stuffs from the cities/towns to the coastal villages and vice versa. To make this possible, we must have new roads constructed to these coastal villages/towns at a cost.

Ghana is fortunate to have a major water body along the southern boundary of the country, i.e. the Atlantic Ocean/Gulf of Guinea and a major river body [Fig. 1], the Volta Lake linking the southern section to the northern section, and when used judiciously can improve upon the transportation system in Ghana by reducing the pressure on the use of the road networks. Along this lake and the coast are towns, communities, villages that depend on the use of these water bodies for their livelihood and business activities. Moving from one settlement to the other either along the water body or across has always been a huge problem. The use of fishing canoes has been the available mechanism for transporting people and goods which has endangered lives over the past periods due to unavailability of safety measures. In view of this situation, if the use of the water body will take approximately 30 minutes to move from one place to another, and by land, 3 hours, majority of travelers would prefer to use the land due to fear in the use of the water body.



Fig. 1 Map of Ghana showing the Lake

But the major issue about this development is how safe and reliable is the use of water bodies for transportation? Safety in the use of our water bodies depends greatly on the nature of the water bodies, their depths and what is below the surface of the water. Under this condition, the application of hydrographic surveying will provide solutions to determine safety in the use of the water body for transportation.

2.0 TRANSPORTATION SYSTEM IN GHANA

2.1 Geography of Ghana

Ghana is located on West Africa's Gulf of Guinea only a few degrees north of the Equator. Half of the country lies less than 152 meters (500 ft.) above sea level, and the highest point is 883 meters (2,900 ft.)

It lies on the Western Coast of Tropical Africa, bordering the North Atlantic Ocean between Cote d'Ivoire and Togo

N→S 672 km, b/n latitudes 4.5°N and 11°N;

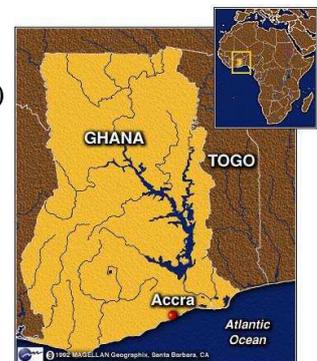
E →W 536 km b/n longitudes 3°W and 1°E.

Land boundaries: total 2,093 km, Burkina Faso 548 km, Cote d'Ivoire 668 km, Togo 877 km

Coastline: 539 km by the Gulf of Guinea and the Atlantic Ocean.

Map references: Africa, Standard Time Zones of the World

Area -total area: 238,540 km²; land area: 230,020 km².



The 539-kilometer (334-miles) coastline is mostly a low, sandy shore backed by plains and scrub and intersected by several rivers and streams, most of which are navigable only by canoe.

2.2 Transportation

Transportation in Ghana has largely dependent on the use of our road system and to a small extent the water system, rail system and by air [Fig 2]. Road transport is by far the dominant carrier of freight and passengers in Ghana's land transport system. The dominant use of the roads has caused a lot of pressure on our road networks leading to their early damages. It carries over 95% of all passenger and freight traffic and reaches most communities, and is classified under three categories of trunk roads, urban roads, and feeder roads.

Increased transport investment helped to increase the number of new vehicle registrations and transportation alternatives include rail, road, ferry, marine and air [6]. There has been an increased investment and expansion in the road transportation of Ghana [1], hence with respect to this mode of transport, many people prefer to use the road means of transport for their movements than the use of the other transportation alternatives.



Fig. 2 *Transportation in Ghana*

2.2.1 The Volta River/Lake

The Volta River is the main fresh water source for Ghana. It is a stream primarily in Ghana that drains into the Gulf of Guinea and Atlantic Ocean and has three main tributaries—the Black Volta, White Volta and Red Volta [Fig. 3]. The Volta River is formed by the confluence of the Black Volta and the White Volta rivers at Yeji in the central part of the country [7]. The river flows in a southerly course through Lake Volta to Ada on the Gulf of Guinea. The total length, including the Black Volta is about 1,500 km (930 miles).

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Fig. 3- *The Volta River and the Three Main Tributaries*

The Volta Lake was created by the construction of the Akosombo dam on the river in the mid 1960's. At about 8482 square km (3275 square miles) [5], the lake is one of the largest artificially created lakes in the world. Lake Volta (located at $6^{\circ}30'N$ $0^{\circ}0'E$ / $6.5^{\circ}N$ $0^{\circ}E$ / $6.5; 0$) is the largest reservoir by surface area in the world, and the fourth largest one by water volume. It is located completely within the country of Ghana, and it has a surface area of about 8,502 km² (3,275 square miles). Lake Volta lies along the Greenwich Meridian, and just six degrees of latitude north of the Equator. The lake's north most point is close to the town of Yapei, The Volta Lake is a man-made lake created after the River Volta was dammed at the Akosombo gorge. The lake was created to store up water primarily to generate hydro- electricity. Additionally it was envisaged that it would improve inland water transport, boost fishing, ensure enough water for domestic and industrial use and for irrigation, etc.

Although the country boast of limited number of bridges over the Volta River, Ghana has only one Suspended Bridge called the Akosombo Bridge which spans over the Volta River at Atimpoku and it is reputed to be among the few found all over the world. This important tourist attraction which is a masterpiece of civil and architectural work was built in 1956 and has a total length of 805 feet. It provides the vital road transportation piece over the Volta River thus linking by road the central and northern parts of the Volta Region with the other parts of the country especially the Eastern Greater Accra, Ashanti, Central and Western Regions.

Along this river and the coast are towns, communities, villages that depend on the use of these water bodies for their livelihood and business activities [Fig. 4]. The use of fishing canoes and small boats have been the available mechanism for transporting people and goods which has endangered lives over the past periods due to unavailability of safety measures. For this reason,

many people have avoided the use of water bodies for transporting them from one place to another.



Fig. 4- Panorama and landscape of Lake Volta in Ghana

The Volta River/Lake is termed to be a killer because since the gorge was flooded in 1966, thousands of hardwood trees were left standing. Many of them lied in ambush below the water surface much of the year where they snag the nest of fishermen and are a source of danger for the long wooden kayaks and other boats that transport goods and people. The presence of these tree stumps under the surface of water bodies and lack of proper marking of safe channels for navigation by the fisher folks and the communities along the lake over the past decades have caused various categories of river/lake disasters which have led to the loss of lives and valuable items.



Fig. 5-Hard wood trees and tree stumps left standing in the Volta River

3.0 THE STATE OF HYDROGRAPHIC SURVEYING IN GHANA

Firstly it is necessary to consider the IHO definition of Hydrography, which stands as follows:

“That branch of applied sciences which deals with the measurement and description of the features of the seas and coastal areas for the primary purpose of navigation and all other marine purposes and activities, including –inter alia- offshore activities, research, protection of the environment, and prediction services”, (IHO Pub. S-32), cited in the Hydrographic Manual, 2005 [2]. With this definition, one can allude to the fact that most of the water bodies in the country have not been measured or chartered to know if they are safe for navigation. Until the recent discovery of oil and gas in the country, hydrography is as less known area that only a few people would venture into because there is no demand for it in the country.

A national Hydrographic Service or a private hydrographic agency for national and international duties in hydrography does not exist at the moment. The existing organization that perform hydrographic activities in the country as shown in fig 6 operate separately and independently and for that matter do not collaborate and this makes it uneasy to know the actual difficulties which the ministries, authorities and the offices are encountering. Even though there are packets of hydrographic survey works done in the country, there are no records or data with the survey and mapping division because they were initiated by private firms for their individual needs or construction purposes. The Volta lake which is the largest man-made lake in the world and span from the south to the north even into neighboring Burkina Faso could serve as the most convenient means of transport of goods and services from the south to the north but then this is not the case simply because most part of the lake have not been surveyed.

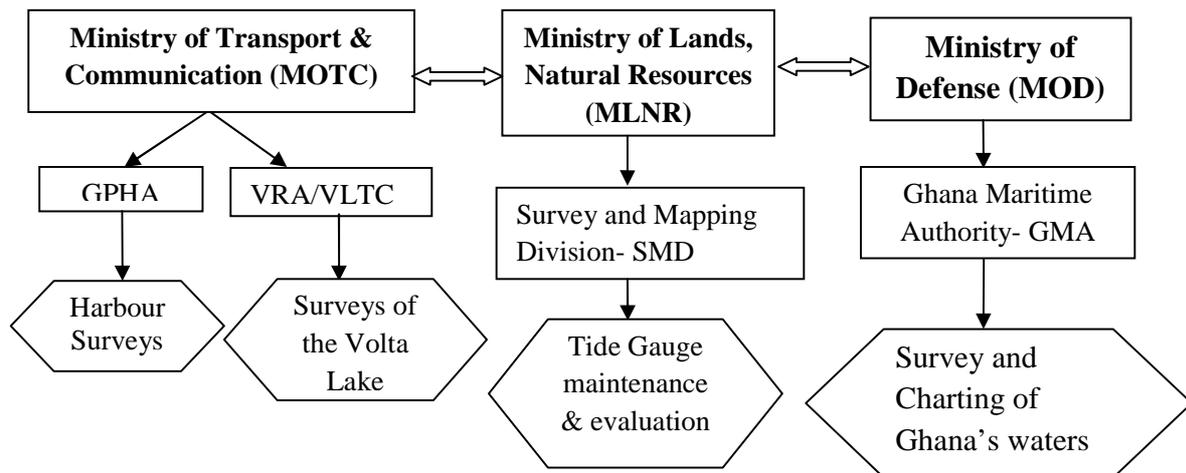


Fig. 6- Organizations that perform Hydrographic Activities

Normally, the Ghana Ports and Harbour Authority (GPHA) and the Volta Lake Transport Company (VTLC) who are under the Ministry of Transport should be responsible for the harbours and lake surveys but they do not have common hydrographic surveys. It was therefore very difficult to obtain documents on hydrographic surveys on the coastal waters or the EEZ.

Only GPHA has information on the two main Harbours in the country concerning the results of their hydrographic surveys.

3.1 Current Activities by Hydrographic Agencies & Changes

Various agencies are involved in the field of hydrographic surveying in relation to their field of operations and have established hydrographic sections in their outfits operating on minor scales. These agencies as below either perform activities in relation to hydrography or have established hydrographic sections in their outfits operating on minor scales.

3.1.1 Survey and Mapping Division

Apart from the geodetic survey activities in the country, the Division is also responsible for the operation and the maintenance of the automatic tide gauges at Takoradi and Tema. They are also responsible for the compilation of data from the observations which help in the tidal levels prediction.

3.1.2 Ghana Ports and Harbours Authority (GPHA)

The GPHA with its headquarters at Tema is the only authority responsible for hydrographic surveys in Tema and Takoradi harbours. The Hydrographic Section under this authority has nothing to do with the coastal surveys including the EEZ. Its functions include dredging to maintain depths, laying and maintenance of all buoys, salvaging sunken craft, checking position and distance of mooring buoys, harbor soundings and compiling harbor charts. Since the establishment of the two harbours, there has been to some extent the activity of hydrographic surveying taken place there.

3.1.3 Volta River Authority/Volta Lake Transport Company (VRA/VLTC)

The VRA was established in April, 1961 mandated to operate mainly as a power generation, transmission and distribution utility. It is also responsible for the visual tide gauge. Readings of the water levels are taken daily at an hour intervals, and later on a time-height graph is drawn. A graph of the annual maximum and minimum water levels is obtained from the analysis of the level readings.

The VLTC incorporated in 1970 operates river transportation for passengers, bulk haulage of petroleum products and cross-lake ferry services along the Volta Lake. They depend on the maximum and minimum water levels for their operations. Its activities play an important role in Ghana's economic development. The VLTC depends on the statements made by the ferry crew and some fishermen about the local changes. Since 1988 that echo sounders were used to carry out hydrographic surveys at some ferry stations along the Volta Lake, no surveys have been conducted again.

3.1.4 Ghana Maritime Authority (GMA)

The Technical Services Division of the authority is responsible for the effective coordination of the technical services. Its activities in the field of hydrography and navigation are as follows:

- Provide navigation services along the coast of Ghana including collation and dissemination of tidal, current and weather information
- Undertake survey and chart Ghana's waters, preparation of charts and dissemination of relevant information on drafts along the coast
- Install, inspect and maintain lighthouse, buoys and other aids to navigation
- Demarcate safe water channels and waterways

- Carry out and identify marking, notification and removal of wrecks and other hazards to navigation
- Review and authorize the location of underwater cables, pipelines, terminal points, rigs and other offshore installations
- Handle environmental issues in respect of coastal and offshore developments
- Undertakes preliminary investigation of maritime accidents and casualties in collaboration with other departments
- Assist in the collection and compilation of hydrographic data for navigational charts and publications and other applications to meet standards of international organizations
- Assist in the production and distribution of charts and publications
- Assist in directing operations to find, position and chart new dangers to navigation
- Provide navigation services along the coast of Ghana including collation and dissemination of tidal, current and weather information
- Install, inspect and maintain lighthouse, buoys and other aids to navigation
- Conduct preliminary investigations of maritime accidents and casualties in collaboration with other department

4.0 THE IMPORTANCE OF HYDROGRAPHIC SURVEYING AND ITS BENEFITS TO THE ECONOMY OF GHANA

Due to the increase of population living in the coastal region and along the banks of rivers, there is increase of activities that discharge different elements into the sea and other water bodies. In view of this situation, society must be keen to consider, with sufficient priority, the need to have reliable hydrographic information to adopt the most efficient and effective preventive and remedial measures to ensure clean seas. These water bodies, both natural and artificial have been considered as natural features and have brought about interconnectivity between different human groups mainly to exchange their goods and create movement from one place to another. In order to make movement from one place to the other very safe, the best medium of transportation is the use of the water body for that purpose. Therefore, hydrography and the representation of its

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results in a nautical chart have always been part of life and have contributed to mankind's development as well. In view of this, hydrographic surveying need to be conducted to measure the depth and bottom configuration of water bodies to produce the nation's nautical charts to ensure Safe Navigation on the water bodies. The activity will "look" into the waterbody to see what the floor looks like and also identify floor materials (important for anchoring, dredging, pipelines and cable routing) dredging areas, cables, pipelines, wire pipelines, wrecks and obstructions and fish habitats.

The Volta Lake which is the largest man-made lake in the world and span from the south to the north even into neighbouring Burkina Faso could serve as the most convenient means of transport of goods and services from the south to the north. The Transport service on the Volta Lake is hampered by the perennial low water level as well as the presence of tree stumps and sand banks that impede the smooth movement of vessels and boats. Recent developments include a large-scale enterprise to harvest submerged timber from the flooded forests under Lake Volta [8]. This project harvests high-value tropical hardwood without requiring additional logging or destruction of existing forest and, according to Wayne Dunn, "could generate the largest source of environmentally sustainable natural tropical hardwood in the world [4]. This underwater forest activity will make the lake more navigable and safe and could generate the largest source of environmentally sustainable natural tropical hardwood in the world.



Fig. 7- a mahogany tree that was pulled from Volta Lake

This project if successfully conducted would clear a transportation path for boats and water body users, provide social improvements in the form of jobs for some residents and greater boating safety for others; and reducing the threat to forest environments by satisfying demand for ebony,

mahogany, and other hardwoods without removing living trees. The success of this project will depend on the conduction of a hydrographic survey because this activity would answer the following questions:

- How many trees or tree stumps are beneath the lake and their specific locations;
- The sizes of the trees and their depths beneath the surface of the water body.

Answers to the following questions will determine the method and technology to apply to operate under the water for the successful removal of the trees.

With reference to Ghana Government's objectives on transport and growth as indicated in the Ghana Poverty Reduction Strategy (GPRS) II, that involved the following:

- Ensure the provision, expansion and maintenance of transport infrastructure of all kinds
- Ensure the provision of affordable, safe and accessible transportation system that recognizes the needs of people and business enterprises including farmers
- Develop and strengthen the appropriate legal, institutional and regulatory framework to regulate all modes of transportation to ensure an efficient transportation system.

The objective above defines a clear indication that developing the water bodies to be used for transportation would bring about a vast improvement in the transportation system of the country.



Fig. 8- A motorist canoe carrying passengers, food etc navigating around tree stumps

Again, the Government through the Eastern Corridor Project has selected some settlement areas for the construction of landing stages or Inland Ports and the achievements of these projects cannot be achieved without the assistance of hydrographers and other allied professionals. The project when completed would be of great benefits to the economy of the country, and these would include;

- Transportation of cargo from the south to the north and neighbouring Burkina Faso.
- Transportation of food stuffs from the north to the south.
- Reduction in loss of lives through accidents on the lake due to bad weather and presence of tree stumps.
- Ease of pressure on roads resulting in long life span of road network in the country.
- Create business opportunities and jobs for the youth and people of Ghana.

The conduct of hydrographic surveying would again adequately address areas [3] such as:

- Safe and efficient operation of maritime traffic control;
- Coastal Zone Management;
- Exploration and Exploitation of Marine Resources;
- Environmental Protection and Management;
- Maritime Boundary Delimitation.
- Maritime Defense
- Maritime Transport
- Tourism and Recreational Boating

5.0 CHALLENGES IN HYDROGRAPHIC AFFAIRS

- Non-existence of a Ghana National Hydrographic Service.
- Lack of Hydrographic surveying and Ocean Observation equipments, i.e. Research Vessels to conduct the surveys.
- Non-membership of International Hydrographic Organization (IHO)
- Unavailable capacity to process the measured data
- Non-existence body to control the activities of the various institutions
- Absence of Human Resource development training

5.1 FUTURE PLANS

- The need to establish the Ghana National Hydrographic Service [2] to run it under the Ministry of Lands and Natural Resources.
- Strengthen the various institutions that are into the field of oceanography and hydrography. This will greatly involve the training of personnel in the departments and students in the following institutions:
 - Kwame Nkrumah University of Science and Technology (KNUST) that offers hydrographic surveying as a subject.
 - Department of Oceanography and Fisheries, at the University of Ghana, Legon offering degree course in Oceanography and Fisheries.
- Consult the International Hydrographic Society for advice, guidance and financial assistance.
- Develop Inland Ports within the country at strategic Site Locations
- Rehabilitate the existing harbours into higher international standards to be able to handle any oceanic and hydrographic activity.
- Apply for membership into IHO.

6.0 CONCLUSION

This paper attempts to create awareness to the fact that Transportation means in Ghana can be improved by the use of water bodies within the country. Again, there is the need to conduct hydrographic surveys on our water bodies to determine its safety for transportation. This work is of high significant to National Development of a country in the area of transportation. The use of the water body for transportation will reduce the over dependence on road transportation by creating another alternative thereby creating job for the people. If hydrographic surveying is conducted on our water bodies, the results would be used to determine the level of safety in its use for the development of a Water Transportation System. It would also create the awareness in the importance of hydrographic surveying to determine the safety in the use of the water body. This write-up concludes that the Water Transportation System can be one of the cost effective and safest modes of transportation in Ghana and the development of the system can be made possible to the highest level of safety with the conduction of a hydrographic survey to determine the topography of the Volta Lake.

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BIOGRAPHY

Mr. Isaac Larbie is a Geomatic Engineer in the Survey and Mapping Division (SMD) of Lands Commission, under the Ministry of Lands and Natural Resources. He is the Head of Lithographic (Printing) Section and also Head of Hydrographic Unit, all of SMD. He holds a Masters Degree in Geoinformatics from ITC, Enschede, Netherlands and B.Sc. Geodetic Engineering (2nd Class Upper Division). Has worked with SMD since 1995 till date as a Professional Land Surveyor and has upgraded his skills and knowledge in the following training programmes:

- 50th UNB-OMB / UNH-CCOM Multibeam Sonar Training Course in Stavanger, Norway, March 16 to 21, 2009 co-hosted by The Norwegian Hydrographic Service.
- On-board the Research Vessel Dr. Fridjof Nansen to conduct Bathymetric Mapping for Marine Environmental Monitoring Survey, May 9 to 16, 2009.
- "Ocean Observation and Hydrographic Survey" Training Course in the Republic of Korea, July 6 to July 25, 2009.
- On-board the Research Vessel Dr. Fridjof Nansen to conduct Bathymetric Mapping for Marine Environmental Monitoring Survey, 2nd to 15 November, 2012.

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He is a member of the Ghana Institution of Surveyors (GhIS) as a Professional Member in the Land Surveying Division since 2007 and has performed many duties in the following capacities:

- Executive Member, Land Surveying Division, 2010-2013
- Member of Governing Council, 2011 till date.
- Member of AGM Planning Committees, 2011-2013
- Vice Chairman, 2011 Land Surveying Division Annual Seminar Planning Committee.
- Chairman, 2013 Land Surveying Division Annual Seminar Planning Committee.
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